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BEFORE THE BOARD OF PATENT APPEALS AND INTERFERENCES

Application Number: 10/725,795
Filing Date: December 02, 2003
Appellant(s): OU-YANG, CHIEH

Steven J. Solomon
For Appellant

EXAMINER'S ANSWER

This is in response to the appeal brief filed December 17, 2008 appealing from the Office action mailed June 11, 2008.

(1) Real Party in Interest

A statement identifying by name the real party in interest is contained in the brief.

(2) Related Appeals and Interferences

The examiner is not aware of any related appeals, interferences, or judicial proceedings which will directly affect or be directly affected by or have a bearing on the Board's decision in the pending appeal.

(3) Status of Claims

The statement of the status of claims contained in the brief is correct.

This appeal involves claims 1, 5-10, 12, and 13.

Claim 5 has been amended subsequent to the final rejection, in an after-final amendment filed November 10, 2008. The 35 USC 112, 2nd paragraph rejection set forth in the final rejection was subsequently withdrawn in the advisory action of November 20, 2008.

(4) Status of Amendments After Final

The appellant's statement of the status of amendments after final rejection contained in the brief is correct.

(5) Summary of Claimed Subject Matter

The summary of claimed subject matter contained in the brief is correct.

(6) Grounds of Rejection to be Reviewed on Appeal

The appellant's statement of the grounds of rejection to be reviewed on appeal is substantially correct. The changes are as follows: Ground C.) should state: Whether claim 9 is unpatentable under 35 USC § 103(a) over Shirley in view of Mandal et al. *or Kim et al.*

(7) Claims Appendix

The copy of the appealed claims contained in the Appendix to the brief is correct.

(8) Evidence Relied Upon

6,322,626	SHIRLEY	11-2001
5,932,009	KIM ET AL.	8-1999
6,174,651	THAKUR	1-2001
6,238,735	MANDAL ET AL.	5-2001

(9) Grounds of Rejection

The following ground(s) of rejection are applicable to the appealed claims:

The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

> A person shall be entitled to a patent unless –
>
> (b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

Claims 1 and 6-8 are rejected under 35 U.S.C. 102(b) as anticipated by or, in the alternative, under 35 U.S.C. 103(a) as obvious over Shirley (US 6,322,626).

Shirley is directed to a method and apparatus for controlling the temperature of a microelectronics substrate. Shirley discloses control of the temperature of a substrate in both a chill plate assembly 20 and a coater bowl assembly 30 (both illustrated in Figure 1; col. 3, lines 12-24). Shirley teaches that the temperature of a substrate is first controlled in the chill plate assembly 20 by cooling the substrate after it has received a coating of primer in a high temperature process (col. 3, lines 25-29 and col. 4, lines 28-57), and then the cooled substrate is transferred to the coater bowl assembly 30 where it receives a liquid coating thereon by a spin coating process.

With respect to the coater bowl assembly 30, Shirley teaches a method of distributing a viscous liquid over a surface of a substrate by a spin coating process comprising: placing a substrate essentially horizontal on a support; applying a viscous liquid onto a surface of the substrate; rotating the substrate to distribute the liquid radially outwards; and a step of conditioning the substrate thermally to locally influence its viscosity by creating a local temperature gradient (col. 4, line 43 to col. 5, line 14; col. 5, lines 33-50), said thermal

conditioning being effected by a thermal source of heat or cold comprising a stream of heated or cooled gas.

With respect to the limitation in claim 1 requiring that the thermal source of heat or cold in the coater bowl is placed *above* the surface of the substrate, Shirley teaches that "the bowl temperature controller 50b can include a plurality of heat exchangers 52b and manifolds 54b, arranged in a manner generally similar to that discussed above with reference to the plate temperature controller 50a" in col. 5, lines 10-14. With respect to the chill plate section of the apparatus, Shirley teaches that orifices 55a which apply heated or cooled gas can be positioned proximate to the front (upper) side of the substrate 72 rather than the back side 71. Thus, it is the Examiner's position that Shirley teaches coating the substrate in Shirley's coater assembly using the claimed method of selective thermal conditioning by directing a stream of heated or cooled gas to the substrate from *above* the substrate surface since Shirley teaches that the coater bowl temperature controller may be arranged in a manner similar to the chill plate temperature controller, which includes use of orifices positioned above the substrate.

Alternatively, it would have been obvious to one having ordinary skill in the art to have incorporated the optional embodiments of the chill plate assembly, such as positioning the orifices above the substrate rather than below the substrate, in Shirley's coater assembly, with the expectation of similar and successful results because both Shirley's chill plate and coater assemblies have similar structures, effects, and purposes -- to similarly provide heating or cooling to selected areas of a substrate to provide a temperature gradient on the substrate, and because Shirley specifically teaches the incorporation of the features of the chill plate assembly into the coater bowl assembly.

As to claims 6-7, Shirley teaches the use of a plurality of sub-sources directed to different positions on the radius of the substrate.

As to claim 8, Shirley's substrate is supported on a rotatable support, with liquid dispensing means provided above the substrate surface. While Shirley does not illustrate the disclosed embodiment where cooling and heating means are provided above the substrate, there would necessarily be fastening means for supporting the thermal source(s) because it is not possible for the thermal sources to float unsupported above a substrate.

Claims 10 and 12-13 are rejected under 35 U.S.C. 103(a) as being unpatentable over Shirley.

With respect to claims 10 and 13, Shirley is silent as to the means used to support the thermal means in an embodiment where the thermal sources are provided above the substrate. It is the Examiner's position that it would have been obvious to one having ordinary skill in the art to have provided the thermal means above the substrate on an arm because use of an arm to hold various apparatus means over the top of a substrate is well known in the spin coating art. For example Shirley illustrates the use of an arm to hold the liquid dispenser above the substrate. Further it would have been obvious to an engineer skilled in the art to have made the arm movable so that the substrate can be easily placed in and removed from the coater assembly without bumping into the thermal sources. As to claim 12, it is the Examiner's position that it would have been obvious to have mechanically affixed the liquid dispensing means to the thermal fastening means in order to minimize and simplify the number of parts on the coater assembly.

Claim 9 is rejected under 35 U.S.C. 103(a) as being unpatentable over Shirley as applied to claims 1 and 8 above, and further in view of Mandal et al. (US 6,238,735) or Kim et al. (US 5,932,009).

With respect to claim 9, Shirley lacks the teaching of a cover extending over the rotatable support. The Examiner notes that use of a cover over a spin coating apparatus is very well known in the spin coating art. Mandal et al. and Kim et al. are cited to demonstrate the conventionality of a cover to provide an enclosed process space. It would have been obvious for one having ordinary skill in the art to have used a cover in the spin coating apparatus of Shirley in order to insulate the process space and prevent all the cooling and/or heating gases from dissipating before they can effectively cool/heat the substrate.

Claims 1, 5-10, and 12-13 are rejected under 35 U.S.C. 103(a) as being unpatentable over Kim et al. (US 5,932,009) taken in view of Thakur (US 6,174,651).

Kim et al. discloses a method of distributing a viscous liquid over a surface of a substrate by a spin coating process comprising: placing a substrate essentially horizontal on a support; applying a viscous liquid onto a surface of the substrate; rotating the substrate to distribute the liquid radially outwards; and conditioning the liquid on the substrate thermally to influence its viscosity locally by creating a locally selective temperature gradient. The thermal conditioning in Kim et al. is effected by infrared radiation as the thermal source of heat (col. 4, lines 48-65). Kim et al. teaches that a plurality of optical cables for guiding infrared radiation may be positioned at different radial locations under the chuck (see Figure 5 and col. 5, lines 25-31).

Kim et al. lacks a teaching of placing the radiation source *above* the surface of the substrate. However, it is noted that Kim et al. states "In addition to the method using the infrared generator 51 and optical cable 52 for the purpose of heating the rotation chuck 113, it is possible to use other electromagnetic waves as well" (col. 5, lines 44-46).

Thakur is cited for its teaching of similarly distributing a viscous liquid over a surface of a substrate by a spin coating process and conditioning the liquid on the substrate thermally to solidify the liquid (for example by evaporation of the solvent therein - col. 7, lines 45-47). Thakur teaches and illustrates using two lamps 24, 26 which can emit optical energy by visible light which are placed above the surface of the substrate (col. 7, lines 10-23 and Figure 1A). Thakur further teaches that "As many lamps as are necessary for the process may be used and the lamps may be placed *in any suitable configuration*. The location of the lamps illustrated in the Figures is merely exemplary" [emphasis added] (col. 7, lines 61-65). Thakur also discloses "the energy emitted by the lamps can be easily and precisely controlled and varied." It would have been obvious for one having ordinary skill in the art, seeing the references of Kim et al. and Thakur in combination, to have heated the substrate and coating liquid thereon in a temperature gradient (as taught by Kim et al.) by using radiation applied from above the substrate (as taught by Thakur) in place of radiation applied from below the substrate with the expectation of similar and successful results.

As to claims 6-7, Kim et al. teaches that the radiation is directed to multiple different positions with regard to the radius on the substrate. The multiple different positions meet the limitation of "at least two sub sources."

As to claims 8 and 10, in Kim et al., the substrate is supported on a rotatable support, with liquid dispensing means provided above the substrate surface. Thakur illustrates the use of fastening means, including an arm, to hold the thermal sources above the substrate.

As to claim 9, both Kim et al. and Thakur illustrate the use of a cover extending over at least part of the substrate.

As to claim 13, it is the Examiner's position that it would have been obvious to one having ordinary skill in the art to have made the arm holding the thermal source movable in the process of Kim et al. taken in view of Thakur so that the substrate can be easily placed in and removed from the coater assembly. As to claim 12, it would have been obvious for a skilled engineer to have mechanically affixed the liquid dispensing means to the thermal fastening means in order to minimize and simplify the number of parts on the coater assembly.

(10) Response to Argument

Applicant argues the legal standards to be used in anticipation rejections under 35 USC 102(b) and obviousness rejections under 35 USC 103(a), and provides summaries of the Shirley, Kim et al., and Thakur references. The Examiner notes these legal standards and summaries.

With respect to the 35 USC 102(b)/103(a) rejections over Shirley, Applicant separately addresses the rejections under 35 USC 102(b) and 35 USC 103(a).

As to the rejections under 35 USC 102(b) over Shirley, Applicant argues that no coating is applied to the substrate in the chill plate assembly 20, so there is no impediment to providing temperature control from above the substrate 70 versus below it. However, Applicant argues that, conversely, temperature control from above is avoided in the coater bowl assembly 30 so as

not to interfere with the deposition of liquid to the upper surface of the substrate 70. The Examiner disagrees with this last statement. Temperature control from above is not "avoided" in Shirley's coater bowl assembly 30, but rather is just not mentioned at all. However, the Examiner notes, as discussed in the rejections above, that Shirley states "the bowl temperature controller 50b can include a plurality of heat exchangers 52b and manifolds 54b, *arranged in a manner generally similar to that discussed above with reference to the plate temperature controller 50a* [emphasis added]" in col. 5, lines 10-14. Thus it is the Examiner's position that Shirley specifically teaches that the arrangement of the temperature controller of the coater bowl assembly 30 may be similar to the arrangement of the temperature controller of the chill plate assembly 20 - which includes use of temperature control applied from above the substrate.

Applicant argues that the plain meaning of the above quoted language is that a plurality of heat exchangers and manifolds 52b, 54b, which were already described previously for the plate temperature controller, is an alternative to the single heat exchanger and manifold described previously for the bowl temperature controller. Applicant states that there is no implication that the location of the bowl temperature controller 50b can or should be changed, to place it above the substrate. The Examiner disagrees with this interpretation. While this passage does disclose use of a plurality of heat exchangers and manifolds, it also teaches that the *arrangement* may be similar to that of plate temperature controller 50a. It is the Examiner's position that one having ordinary skill in the art would have seen this teaching by Shirley ("the bowl temperature controller 50b can include a plurality of heat exchangers 52b and manifolds 54b, *arranged in a manner generally similar to that discussed above with reference to the plate temperature controller 50a* [emphasis added]"), and would have recognized that the "arrangement" of the

bowl temperature controller is not only limited to the use of a plurality of heat exchangers and manifolds, but also the location and set-up of the heat exchangers and manifolds and orifices taught with respect to the plate temperature controller 50a. Thus it is the Examiner's position that the cited section indicates that any of the discussed features of the plate temperature controller 50a, including the location of the manifold, orifices, etc., may be incorporated into the bowl temperature controller 50b.

Applicant argues that had Shirley intended such an alternative, the reference could have easily described it, yet Shirley contains no such teaching. The Examiner disagrees and maintains that the above-quoted sentence does indeed provide the teaching. Secondly, it is noted that the lack of a specific teaching is not necessarily a teaching to the contrary.

With respect to the 35 USC 103(a) rejections over Shirley, Applicant argues that the location of the bowl temperature controller 50b in Shirley cannot be shifted to above the substrate 70 in the coater bowl assembly 30 because at least the central nozzle/manifold 53a from the chill plate assembly 20 would interfere with or displace the liquid nozzle 35, which is centrally located above the substrate in the coater bowl assembly 30. Applicant argues that the liquid nozzle 35 in Shirley cannot be readily moved or "adjusted" as the Examiner suggests because this would displace the liquid nozzle 35 and result in non-uniform coverage of the liquid on the spinning substrate and ineffective radial temperature gradient. It is not the Examiner's intention to modify the Shirley reference such that liquid is applied other than at the rotation center of the substrate. The Examiner notes that Shirley discloses the general inventive concept of providing a temperature gradient using heated or cooled gas from positions located above the

surface of the substrate. The Examiner maintains the position that it would have been within the skill of an engineer having ordinary skill in the art to have determined an appropriate configuration of its device such that the radial gas jets are located above the substrate in combination with the nozzle at the center. For example, the manifold may be constructed such that the nozzle fits in the center of radial gas jets. A suitable configuration would be determined by an engineer in the art, having already known the general inventive concept taught by Shirley and having recognized that some adjustments to the specific construction of the apparatus would be required when incorporating the alternative suggested embodiments of Shirley.

Applicant further argues that whether a skilled engineer could produce the suggested construction is not the appropriate inquiry, but rather would a person of skill in the art have been motivated to modify Shirley as proposed. Applicant states that Shirley discloses a complete structure, with no hint as to why one might relocate the bowl temperature controller 50b above the substrate instead of below. The Examiner maintains that one having ordinary skill in the art would have recognized that both Shirley's chill plate and coater assemblies have similar structures, effects, and purposes -- to similarly provide heating or cooling to selected areas of a substrate to provide a temperature gradient on the substrate, and that it would have been obvious to have incorporated one of the features of the chill plate temperature controller, such its location above the substrate instead of below it, into the coater bowl temperature controller with the expectation of similar and successful results. *KSR* forecloses the argument that a **specific** teaching, suggestion, or motivation is required to support a finding of obviousness . See the recent Board decision *Ex parte Smith*, --USPQ2d--, slip op. at 20, (Bd. Pat. App. & Interf. June

25, 2007) (citing *KSR International Co. v. Teleflex Inc.*, 550 U.S.--, 82 USPQ2d at 1396) (available at http://www.uspto.gov/web/offices/dcom/bpai/prec/fd071925.pdf).

Applicant argues that the proposed modification is contrary to the conventional expectation that temperature control from above, at the surface where the coating liquid is applied and where it is spreading during spin-coating, would interfere with the application of that liquid on the substrate surface. Further to this point, Applicant states that Shirley explains that arrangement proximate the back side 71 for the plate temperature controller 51a is preferred as "such a method may be less likely to damage components or features on the front side 72," and that it is not obvious from Shirley to employ the less preferred front-side placement when a coating liquid is present. While Applicant's point is noted, the Examiner maintains the position that it would have been obvious to an engineer having ordinary skill in the art, having seen both the similar chill plate assembly 20 and coater bowl assembly 30 in the same reference, both of which provide temperature gradients in similar manners, and having seen Shirley's teaching that "the bowl temperature controller 50b can include a plurality of heat exchangers 52b and manifolds 54b, arranged in a manner generally similar to that discussed above with reference to the plate temperature controller 50a" to have incorporated the optional placement of the temperature controller for the coater bowl assembly above the substrate (as described for the temperature controller of the chill plate assembly) with the expectation of successful results. It is further the Examiner's position that it would have been within the skill of an ordinary artisan to have monitored the heating/cooling and the state of the liquid applied on the substrate and selected the appropriate levels of heating/cooling to be used such that no damage was done to the applied liquid coating.

With respect to the 35 USC 103(a) rejections over Kim et al. in view of Thakur, Applicant argues that in Thakur, lamps or other source of energy are used to vaporize liquid from atomized droplets above or on the substrate, not to achieve any selective temperature gradient in the substrate or in a coating liquid. Applicant also argues that no particular control of individual lamps or of the amount of light or other energy to be applied to one location is regulated relative to another location ("the use of lamps in Thakur would flood the substrate and any coating deposited thereon with EM energy in an uncontrolled way"), and that no precise temperature-gradient control is necessary or desirable in Thakur. The Examiner disagrees. The primary reference of Kim et al. provides the teaching of a desire to use a temperature gradient. The Thakur reference is cited merely for its teaching that heat may be generated on a coated substrate by the use of radiation supplied from above the substrate, instead of from below the substrate. Further, Thakur teaches in col. 8, lines 8-19, that "the energy emitted by the lamps can be easily and precisely controlled and varied" and that light energy can be instantaneously increased. Light energy may be used to apply a gradient of temperatures by using higher wattages or supplying more power to some light sources than others, for example. Further it is noted that Thakur discloses using similar types of EM sources as those disclosed by Applicant, therefore they must necessarily be capable of providing a temperature gradient. It is the Examiner's position that Thakur's lamps would be capable of producing a temperature gradient, as is desired in the process of Kim et al.

With respect to the combination of Thakur and Kim, Applicant argues that they are entirely different processes and that there must be some nexus between Kim and the teaching

sought to be borrowed from Thakur that might suggest the combination. In response to this argument, the Examiner notes that Kim et al. teaches "In addition to the method using the infrared generator 51 and optical cable 52 for the purpose of heating the rotation chuck 113, *it is possible to use other electromagnetic waves as well* [emphasis added]" (col. 5, lines 44-47). Thus Kim et al. suggests one of ordinary skill in the art to look to the prior art for other means of using electromagnetic waves/radiation to supply heat to a coated substrate, particularly to form a temperature gradient on the coated substrate. The Thakur reference provides such a teaching. Applicant further argues that precision is not relevant in Thakur. The Examiner agrees that precision is not as relevant in Thakur, however Thakur clearly teaches that it is *capable* of providing such precision. Thakur states in col. 8, lines 9-10, "the energy emitted by the lamps can be easily and precisely controlled and varied." Also Thakur teaches "As many lamps as are necessary for the process may be used and the lamps may be placed in any suitable configuration" in col. 7, lines 61-63. Further, in col. 9, lines 26-40, Thakur teaches that a temperature controller may control the amount of light energy emitted by each of its lamps (lamps 24, 26, 28), and that there is thus the ability to accurately control the process and the reaction conditions from a remote location. Thus the lamps of Thakur would be capable of precisely and automatically providing a temperature gradient on the substrate in the process of Kim et al.

Applicant argues that in Thakur, heat is used not to regulate the substrate temperature, but to vaporize the deposited droplets to form a solid coating. The Examiner notes that while the purpose for providing heating may be different, Thakur none-the-less provides heat to the coated substrate and regulates the substrate's temperature as discussed in col. 9. Further, Applicant

argues that there is no bulk liquid-phase coating and no liquid-phase spreading in Thakur, so there is no need to induce temperature gradients to regulate spreading. It is the Examiner's position that, regardless of the means used to apply the liquid on to the substrate in both references, Kim et al. and Thakur similarly disclose the use of electromagnetic radiation to heat a semiconductor substrate. Kim et al. generally suggests use of electromagnetic radiation to provide a temperature gradient, but does not provide specific examples. The Kim et al. reference is modified by including the means for providing electromagnetic radiation to a semiconductor substrate as taught by Thakur. (Also, it is noted that Thakur teaches use of rotation to spread its coating liquid in col. 6, lines 14-24.)

With respect to the rejection of dependent claim 9 under 35 USC 103(a) over Shirley et al. in view of Mandal et al. or Kim et al., the rejection is maintained for the reasons discussed above with respect to independent claim 1 and the Shirley reference.

With respect to the rejection of dependent claims 10, 12, and 13 under 35 USC 103(a) over Shirley et al., the rejection is maintained for the reasons discussed above with respect to independent claim 1 and the Shirley reference.

With respect to the rejection of dependent claims 6-8 under 35 USC 102(b)/103(a) over Shirley et al., the rejection is maintained for the reasons discussed above with respect to independent claim 1 and the Shirley reference.

With respect to the rejection of dependent claims 5-10 and 12-13 under 35 USC 103(a) over Kim et al. in view of Thakur, the rejection is maintained for the reasons discussed above with respect to independent claim 1 and the Kim et al. and Thakur references.

(11) Related Proceeding(s) Appendix

No decision rendered by a court or the Board is identified by the examiner in the Related Appeals and Interferences section of this examiner's answer.

For the above reasons, it is believed that the rejections should be sustained.

Respectfully submitted,

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QAS, TC1700